

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF ILLINOIS

UNITED STATES OF AMERICA,

Plaintiff,

vs.

NL INDUSTRIES, et al.,

Defendants,

and

CITY OF GRANITE CITY, ILLINOIS,
LAFAYETTE H. HOCHULI, and
DANIEL M. MCDOWELL,

Intervenor-Defendants.

Civil Action No.

91 CV 00578-JLF

**DEFENDANTS' MEMORANDUM REGARDING (1) THE COURT'S
AUTHORITY TO APPOINT AN EXPERT WITNESS
OR A TECHNICAL ADVISOR, (2) THE MECHANICS
OF EXPERT SELECTION, (3) THE METHOD OF PAYMENT OF
THE EXPERT, AND (4) THE DUTIES OF THE EXPERT**

Defendants NL Industries, Inc., Johnson Controls, Inc., AT&T Corp., Exide Corp., General Battery Corp., Allied Signal Inc., and Gould, Inc. (hereinafter "Defendants") submit this memorandum of law in response to the Court's September 21, 1994 order to show cause why an expert witness should not be appointed to assist the Court with the complex issues presented in this case and to submit nominations for appointment and suggestions as to duties and method of compensation. As discussed below, the Court is fully within its authority to appoint either an expert witness or a technical advisor in the manner described below, and Defendants suggest that the Court appoint such an expert as soon as possible so that the expert can follow the reopening of the administrative record.



ARGUMENT

I. This Court May Appoint Either an Expert Witness or a Technical Advisor to Assist in an Evaluation of the Issues Presently Before the Court.

A. Resolution of this Case Involves Technically Complex Issues

After the administrative record for the Granite City Site (the "Site") is reopened, the final record is likely to contain highly technical information. As this Court is well aware, the central issue in this case is the appropriate residential soil lead cleanup level for the Site. The relationship between the government sponsored Madison County Lead Exposure Study ("Exposure Study") and the appropriate residential soil lead cleanup level will undoubtedly be the subject of significant comments during the new comment period. As has been stated previously, Defendants believe that the results of the Exposure Study demonstrate that U.S. EPA's selected residential soil cleanup level at the Site is completely unwarranted. Comments submitted by Defendants and others on the Exposure Study as it relates to the remedy at the Site will contain scientific discussions on environmental, biological, and health-related issues that are far more technically complex than those encountered in typical evidentiary proceedings. An understanding of the various sources of lead and the effects of those sources on human health is paramount to the Court's evaluation of the appropriate remedy for the Site.

Indeed, the witnesses and experts that were scheduled to testify at the preliminary injunction hearing before the Court last month further demonstrate the complexity of this case. The United States' witnesses included Allan Marcus, a U.S. EPA employee and statistician who was expected to testify on a highly technical and controversial model (which he developed and thus has a self-interest in) used by U.S. EPA to simulate lead blood levels (the "IU/BK Model"), and Paul Mushak, a purported ingestion specialist who was expected to testify on the health effects of lead and the absorption of lead into the body. Many other witnesses were prepared to testify at the hearing on various other technical issues, including lead uptake, lead bioavailability, the transport of lead, and toxicological issues. Defendants' and the City's witnesses included, among others: Robert Bornschein, one of the leading experts in the field of lead exposure, to testify on the Exposure Study and the use of the IU/BK Model to predict blood lead levels in children; Renate Kimbrough, a physician and toxicologist from the Institute for Evaluating Health Risk ("IEHR") and author of the Exposure Study, to testify about the results of the Exposure Study; and Maurice LeVois, also from IEHR, to testify about statistical issues relating to the Exposure Study and the use of the IU/BK Model.

Moreover, as Defendants have previously noted, the current administrative record in this case is grossly inadequate. Indeed, U.S. EPA's so-called agreement to reopen the record demonstrates that U.S. EPA considered its current record to be technically insufficient. Reopening the record permits U.S. EPA

to rationalize retrospectively its previous erroneous decision. Given the technical nature of the information contained in the administrative record, the Court may find that it does not possess sufficient knowledge or training to fully appreciate the deficiencies which are present. An independent expert would be invaluable to the Court to assist it in identifying such deficiencies. As discussed below, this Court has the authority to appoint such an independent expert.

B. The Court Has the Authority to Appoint an Expert Witness or a Technical Advisor.

1. Federal Rule of Evidence 706 Provides This Court With the Authority to Appoint an Expert Witness.

Pursuant to Rule 706 of the Federal Rules of Evidence, this Court may on its own motion appoint any expert witnesses agreed upon by the parties or of its own selection. Fed. R. Evid. 706(a). Such witnesses "shall advise the parties of the witness' findings, if any" and "may be called to testify to the court." Id. The decision of whether to appoint an expert witness is to be left to the discretion of the trial court. Notes of Advisory Committee on 1972 Proposed Rule 706 ("Notes of Advisory Committee") (the inherent power of a trial judge to appoint an expert of his own choosing is "virtually unquestioned"); 11 J. Moore & H. Bendix, Moore's Federal Practice § 706.10 (2d ed. 1994); Scott v. Spanjer Bros. Inc., 298 F.2d 928, 931 (2d Cir. 1962) (judge was acting within his authority where he appointed an expert based on his beliefs that an expert's input would be "valuable" and "impartial assistance

[would] enlighten the jury and himself on issues which [had] become confused because of partisanship in presentation"); United States v. State of Michigan, 680 F. Supp. 928, 962 (W.D. Mich. 1987) (using the authority conferred upon it by Rule 706, court appointed expert to provide it with an "objective and thorough analysis" of whether State had complied with applicable binding requirements "due to [the court's] difficulty in determining from the submissions of the parties" the degree to which the State had complied); Mallard Bay Drilling, Inc. v. Bessard, 145 F.R.D. 405, 406 (W.D. La. 1993) (court-appointed experts may be appropriate where they will "enlighten or enhance the ability of the Court to determine the pending issue"). In fact, if this Court determines that it is unable to evaluate the adequacy of technical information already before it, the Court may appoint a neutral expert even in the absence of the parties' consent. Students of Cal. School for the Blind v. Honig, 736 F.2d 538, 548 (9th Cir. 1984), vacated on other grounds, 471 U.S. 148 (1985).

A number of courts have appointed experts in environmental actions to assist in understanding the technical information and issues presented by such cases. E.g., Webster v. Sowders, 846 F.2d 1032 (6th Cir. 1988); Renaud v. Martin Marietta, 972 F.2d 304 (10th Cir. 1992). While a court may request that the parties submit nominations for a court-appointed expert, a court is not constrained to do so, nor must it make its selection from the list of names provided by the parties. Fed. R. Evid. 706(a). If appointed, such experts must advise the

court of their findings, may be deposed by any party, may be called upon to testify at trial, and may be cross-examined by the parties as well as by the court itself. Id.

The Notes of the Advisory Committee discuss the classic circumstances in which courts often choose self-appointed experts to combat a party's or an expert's lack of objectivity:

While experience indicates that actual appointment is a relatively infrequent occurrence, the assumption may be made that the availability of the procedure in itself decreases the need for resorting to it. The ever-present possibility that the judge may appoint an expert in a given case must inevitably exert a sobering effect on the expert witness of a party and upon the person utilizing his services.

Fed. R. Evid. 706, Notes of Advisory Committee.

Similar to the objectivity concerns behind the Federal Rules Advisory Committee's Note stated above, Defendants are concerned, based on U.S. EPA's recent activities in this case, that U.S. EPA will not objectively consider comments submitted during the new comment period. In August of this year, U.S. EPA began residential soil excavation (without the promised prior notice to the Court) even though it had agreed before the Court to reopen the comment period. As Defendants have stated in other filings with the Court, by conducting residential soil excavation activities that will be the very subject of the new comment period, U.S. EPA is forcing itself to ignore comments submitted by others on the remedy regardless of their technical merit. It is hard to imagine that U.S. EPA would admit that it made a mistake in its remedy selection after it expends millions of

dollars on the residential soil excavation. In addition, U.S. EPA's unjust criticism of the draft Exposure Study, a study commissioned, reviewed, and approved by its sister agency, the Agency for Toxic Substances and Disease Registry ("ATSDR"), is indicative of the lengths that U.S. EPA will go to support its remedy despite the current administrative record's gross inadequacies.

In summary, U.S. EPA has considerable vested interest in retroactively justifying a decision which its own administrative record demonstrates was made arbitrarily, capriciously, and illegally. A court-appointed expert will exert appropriate pressure on the agency to review comments to its proposals objectively.

2. **This Court Additionally Possesses the Inherent Power to Appoint Technical Advisors to Assist in Its Understanding of the Case.***

In addition to any authority conferred by Rule 706, this Court also possesses inherent powers by which it can appoint a technical advisor for the case. Courts have noted that Rule 706 "was not intended to subsume the judiciary's inherent power to appoint technical advisors. The Civil Rules, after all, were never meant to become the sole repository of all of a federal

* The City of Granite City (the "City") has filed a separate memorandum nominating a candidate to provide expert assistance to the Court. The City has requested that Defendants note expressly the City's agreement with Defendants' positions set forth herein, including Defendants' points and authorities supporting the Court's power to appoint a technical advisor.

court's authority." Reilly v. United States, 863 F.2d 149, 156 (1st Cir. 1988). Indeed, the Supreme Court has recognized that federal trial judges possess an "inherent power to provide themselves with appropriate instruments required for the performance of their duties," including the power to "appoint persons unconnected with the court to aid judges in the performance of specific judicial duties, as they may arise in the progress of a cause." Reilly, 863 F.2d at 157, citing Ex Parte Peterson, 253 U.S. 300, 312 (1920).

Unlike expert witnesses, technical advisors typically do not serve as witnesses and may not contribute evidence. E.g., Reilly, 863 F.2d 149. The use of technical advisors is particularly suited to instances, such as the present case, where

the introduction of outside skills and expertise, not possessed by the judge, will hasten the just adjudication of a dispute without dislodging the delicate balance of the juristic role.... The modality is ... to be engaged only where the trial court is faced with problems of unusual difficulty, sophistication, and complexity, involving something well beyond the regular questions of fact and law with which judges must routinely grapple.

Id. at 156-57. The role of such advisors is to "act as a sounding board for the judge -- helping the jurist to educate himself in the jargon and theory disclosed by the testimony and to think through the critical technical problems." Reilly, 863 F.2d at 158. Thus, given the extreme complexity of the technical issues in this case and the lack of objectivity demonstrated by U.S. EPA thus far, this Court should appoint a technical advisor in this case.

C. This Court Should Appoint an Expert Witness or a Technical Advisor Regardless of the Scope of Review Applicable to this Case.

While the United States will likely argue that the Court has no need for the appointment of an expert where the Court's review is restricted to the administrative record, the scope of review undertaken by the Court has no bearing on, and indeed is irrelevant to, whether the Court has the authority to appoint an expert witness or a technical advisor to assist it in its review of the issues. The Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA") in no way limits the extent of scrutiny of the administrative record by the Court and thus does not prohibit the appointment of an independent expert to assist in such scrutiny. See Students of Cal. School for the Blind, 736 F.2d at 548 (court may appoint a neutral expert where the court is unable to evaluate the adequacy of technical information already before the court), vacated on other grounds, 471 U.S. 148. The real reason the United States objects to the appointment of an independent expert is that it does not want the Court to be equipped to conduct a thorough review of its woefully inadequate administrative record.

Indeed, this Court can only uphold implementation of the remedial action selected by U.S. EPA if it is satisfied that the agency did not act arbitrarily and capriciously, i.e., that the agency considered all appropriate information in selecting the Site's remedy and offered an appropriate rationale for the selection. See Renaud v. Martin Marietta Corp., 749 F. Supp.

1545, 1548 (D. Colo. 1990) (a court-appointed expert may be helpful in making a preliminary determination as to whether the methodology employed by an individual is of a type normally relied upon by experts in the field), aff'd, 972 F.2d 304 (10th Cir. 1992). The Court should appoint an expert to help identify the administrative record's inadequacy and to help the Court formulate the appropriate questions which will provide the basis of its ultimate findings. E.g., Reilly, 863 F.2d at 156-57.

In sum, experts function to assist courts in clarifying the difficult issues before them, reconciling the sometimes confusing and contradictory testimony of reputable experts and serving as sounding boards for judges treading in unfamiliar territory. Defendants are confident that the Court, if it appoints an expert, will utilize the expert appropriately.

II. The Mechanics of Expert Selection

The Defendants' nominations for the expert witness or technical advisor are Dr. Willard R. Chappell and Dr. Paul B. Hammond. Dr. Chappell's and Dr. Hammond's resumes are included in Appendix A. As noted above, this Court has broad discretion in the methodology it selects in appointing an expert of its own. Fed. R. Evid. 706(a). Defendants suggest that the Court: (1) review the written credentials of the nominees submitted by the City, Defendants, and the United States; (2) tentatively choose an expert based on those nominations; (3) give the parties an opportunity to comment on the Court's tentative selection; and

(4) then make a final selection. Defendants further suggest that the Court appoint an expert as soon as possible so that the expert can follow the reopening of the administrative record.

III. The Method of Compensation of the Expert

Rule 706(b) of the Federal Rules of Evidence states that "compensation shall be paid by the parties in such proportion and at such time as the court directs, and thereafter charged in like manner as other costs." As a showing of good faith and in an effort to avoid delay in the selection of the expert, Defendants volunteer to initially pay the cost of the expert witness or technical advisor. As noted in Rule 706(b), the cost of the expert should ultimately be charged to the losing party after a determination of the appropriateness of U.S. EPA's remedy.

IV. The Duties of the Expert

The duties of an expert witness or a technical advisor are very broad. E.g., U.S. v. State of Mich., 680 F. Supp. at 962-964. Defendants suggest that the expert witness or the technical advisor perform the following tasks: (1) review the U.S. EPA designated administrative record; (2) identify inadequacies in the U.S. EPA designated administrative record (for instance, whether U.S. EPA ignored relevant information); (3) review all comments submitted on the U.S. EPA remedy at the Site; (4) assess the weight and significance of the Exposure

Study; (5) review any relevant documents outside the administrative record which may be appropriate for inclusion in the administrative record or which are relevant to the remedy at the Site; (6) ask questions of the parties' experts as necessary to understand the record relating to the Site's remedy; (7) prepare an independent report regarding the adequacy of the record underlying the selection of the Site remedy; and (8) answer any questions the Court may have regarding selection of the Site remedy.

CONCLUSION

Defendants respectfully assert that this Court possesses the requisite authority and discretion to appoint either an expert witness or a technical advisor in the manner described above to assist in its determination of the ultimate issues presented by this case and ask that the Court appoint such an expert as soon as possible.

OF COUNSEL:

COBURN & CROFT



Louis F. Bonacorsi
Joseph G. Nassif
One Mercantile Center
Suite 2900
St. Louis, Missouri 63101
(314) 621-8575

Attorneys for Defendant, AT&T Corp.

by: James Schink (LIT)
James Schink
Reed S. Oslan
Kirkland & Ellis
200 East Randolph Drive
Chicago, IL 60601
Attorneys for Defendant
NL Industries, Inc.

by: Dennis P. Reis (LIT)
Dennis P. Reis
William G. Dickett
Sidley & Austin
One First National Plaza
Two South Dearborn, Suite 2576
Chicago, IL 60603
Attorneys for Defendant
Johnson Controls, Inc.

by: David G. Butterworth (LIT)
David G. Butterworth
David B. MacGregor
Morgan, Lewis & Bockius
2000 One Logan Square
Philadelphia, PA 19103
Attorneys for Defendant Exide
Corporation

by: Brent I. Clark (LIT)
Jeryl L. Olson
Brent I. Clark
Seyfarth, Shaw, Fairweather
& Geraldson
55 East Monroe Street
Chicago, IL 60603-5803
Attorneys for Defendant
Gould, Inc.

by:

Karen L. Douglas (lit)

Karen L. Douglas
Merlo, Kanofsky, Brinkmeier
& Douglas, Ltd.
208 South LaSalle Street,
Suite 950
Chicago, IL 60604
Attorneys for Defendant
AlliedSignal Inc.

by:

David G. Butterworth (lit)

David G. Butterworth
David B. MacGregor
Morgan, Lewis & Bockius
2000 One Logan Square
Philadelphia, PA 19103
Attorneys for Defendant
General Battery Corporation

CERTIFICATE OF SERVICE

The undersigned hereby certifies that a true and correct copy of the above and foregoing was mailed this 7th day of October, 1994 to the following counsel of record:

Edward C. Fitzhenry, Jr.
City Attorney
Lueders, Robertson & Konzen
1939 Delmar
P.O. Box 735
Granite City, IL 62040
Representing: Intervenor/Defendant Granite City, Illinois,

George M. von Stamwitz
Armstrong, Teasdale, Schlafly & Davis
One Metropolitan Square
St. Louis, Missouri 63102-2740
Representing: St. Louis Lead Recyclers

Richard J. Pautler
Alphonse McMahon
Peper, Martin, Jensen, Maichel & Hetlage
720 Olive Street, 24th Floor
St. Louis, Missouri 63101
Representing: Southern Scrap,
Iron & Metal Company, Inc.

J. Martin Hadican
225 South Meramec - Suite 832
Clayton, Missouri 63105
Representing: Ace Scrap Metal Processors, Inc.

Allan M. Goodloe, Jr.
Thompson & Mitchell
P.O. Box 750
525 West Main Street
Belleville, Illinois 62222
Representing: First Granite City National Bank

Frederick J. Hess
William E. Coonan
United States Attorney
Southern District of Illinois
750 Missouri Avenue, Room 330
East St. Louis, Illinois 62201
Representing: United States of America

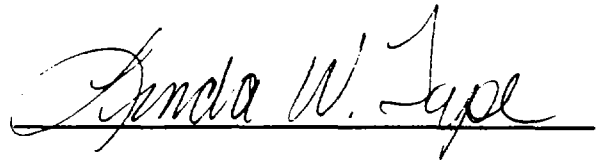
Mark Nitczynski
Timothy Burns
John Lee
U.S. Department of Justice
Environmental Defense Section
P.O. Box 23986
Washington, D.C. 20026-3986
Representing: United States of America

A copy of the foregoing was sent via Federal Express this
7th day of October, 1994 to the following counsel of record:

Jack Grady
Leonard M. Gelman
U.S. Department of Justice
Environmental Enforcement Section
10th & Pennsylvania
Washington, D.C. 20530
Representing: United States of America

Helen Keplinger
Attorney-Advisor
U.S. Environmental Protection Agency
Office of Enforcement
401 M Street, S.W.
Washington, D.C. 20460
Representing: United States of America

Steven M. Siegel
Assistant Regional Counsel
U.S. Environmental Protection Agency
Region V
77 West Jackson Boulevard
Chicago, Illinois 60604-3950
Representing: United States of America

A handwritten signature in cursive script, reading "Linda W. Tapp", is written over a horizontal line.

Appendix A

Nominations of PRP-Defendants in Response to Court's Rule 706 Notice

1. Willard R. Chappell, Ph.D.
Curriculum Vitae Attached

In addition to the information set forth in his resumé, Dr. Chappell was chosen by the parties, including U.S. EPA, to participate in the Aspen, Colorado scientific panel. Dr. Chappell was ultimately elected by the panel to be Chairman of the Technical Advisory Committee ("TAC"). The direction to the TAC from the parties was to assess the U.S. EPA's residential lead soil cleanup proposal.

Dr. Chappell has performed studies on behalf of U.S. EPA, as well as lead health studies for the Agency for Toxic Substances and Disease Registry ("ATSDR"). Dr. Chappell was instrumental in the development of the "SEGH" model for toxic exposure assessment on behalf of the Society for Environmental Geochemistry and Health.

2. Paul B. Hammond, Ph.D.
Curriculum Vitae Attached

In addition to the information set forth in his resumé, Dr. Hammond was the principal organizer of the Aspen, Colorado Technical Advisory Committee ("TAC"), which reviewed and assessed U.S. EPA's residential soil lead cleanup proposal. Dr. Hammond was charged with the responsibility of forming the Aspen TAC scientific panel.

From 1979-1996 (fifteen years), Dr. Hammond was and is the principal investigator in a behavioral study of the effects of lead exposure in children. The study is pursuant to a government grant (approximately \$500,000 per year) from the National Institute of Environmental Health Science (NIEHS). Dr. Hammond has previous experience with the Granite City smelter. In the late 1970's, Dr. Hammond was the principal investigator of lead exposure to smelter workers at the National Lead smelter in Granite City when it was in operation. (See reference #36, Pg. 5, of resumé). Dr. Hammond's study was published in 1980 in the Journal of Occupational Medicine.

Dr. Hammond is an established member of the Society of Toxicology, and is currently President of the Metals Specialty Section.

Dr. Hammond has just recently retired from his position as Professor in the School of Public Health at the University of Cincinnati. He has accepted a part-time position as an Affiliate Professor in the Department of Environmental Health at the University of Washington. As a result, he will have the necessary time to assist the Court if appointed.

VITA

Willard R. Chappell

April, 1994

EDUCATION

<u>Institution</u>	<u>Date</u>	<u>Degree</u>	<u>Major</u>
University of Colorado at Boulder	1958 - 1962	B.A.	Mathematics
Harvard University	1962 - 1963	A.M.	Physics
University of Colorado at Boulder	1963 - 1965	Ph.D.	Physics

PROFESSIONAL EXPERIENCE

- 1977 - present Professor of Physics, University of Colorado, Denver, Colorado
- 1977 - present Professor of Preventive Medicine, University of Colorado Medical Center, Denver, Colorado
- 1987 - present Director, Master of Science of Environmental Sciences Degree Program.
- 1979 - 1989 Director, and Founder Center for Environmental Sciences, University of Colorado at Denver
- 1991 (Jan.-Aug) Special Assistant to Assistant Administrator, Agency for Toxic Substances and Disease Registry.
- 1990 - Fall Academic Visitor, Imperial College, University of London.
- 1987 - Spring Academic Visitor, Imperial College, University of London. (May, June).
- 1983 - 1984 Academic Visitor, Imperial College, University of London (Fall Semester) (Sabbatical leave, University of Colorado at Denver)
- 1978 - 1982 Chairman, U. S. Department of Energy Oil Shale Task Force
- 1976 - 1979 Professor Adjoint, Department of Astrogeophysics, University of Colorado at Boulder
- 1976 - 1977 Assistant to the Vice President, Senior Scientist Science Applications, Inc., La Jolla, California (On leave from University of Colorado at Boulder)
- 1975 - 1979 Director, Environmental Trace Substances Research Program University of Colorado

PROFESSIONAL EXPERIENCE (cont'd)

- 1975 - 1976 Chairman, Governor's Scientific Advisory Committee, Colorado
- 1973 - 1977 Professor of Physics and Astrophysics, University of Colorado, Boulder, Colorado
- 1973 - 1975 Member Governor's Scientific Advisory Committee, Colorado
- 1971 - 1978 Director, The Molybdenum Project, University of Colorado
- 1970 - 1973 Associate Professor, University of Colorado, Boulder, Colorado
- 1969 - 1973 Director, University of Colorado-North High College Motivation Program
- 1967 - 1970 Assistant Professor, University of Colorado, Boulder, Colorado
- 1966 - 1967 Postdoctoral Fellow, Lawrence Livermore National Laboratory, Livermore, California
- 1965 - 1966 Postdoctoral Fellow, Smithsonian Astrophysical Observatory and Harvard University, Cambridge, Massachusetts
- 1962 - 1965 National Science Foundation, Graduate Fellow, Harvard and University of Colorado at Boulder

REFEREED PUBLICATIONS*

- 1994 Chappell, W.R., Chaney, R., Hammond, P., Mortensen, M.E., Stark, A., Thornton, I. "Findings of the Technical Advisory Committee for the Smuggler Mountain Superfund Site." Accepted for publication after peer review in Proceedings of the First International Congress on the Health Effects of Hazardous Waste.
- 1994 Anger, W.K., Letz, R.E., Chrislip, D.W., Frumkin, H., Hudnell, K., Kilburn, K.H., Russo, J.M., Chappell, W., Hutchinson, L. "Neurobehavioral Test Methods for Immediate Use in Environmental Health Studies of Adults." Neurotoxicology and Teratology. Accepted for publication.
- 1994 ~~Krasnegor, N.A.~~, Otto, D.A., Bernstein, J., Burke, R., Chappell, W., Eckerman, D.A., ~~Needleman, H.~~ Oakley, G., Rogan, W., Terracciano, G., Hutchinson, L. "Neurobehavioral Testing Strategies for Assessing Potential Effects of Exposure to Toxic Substances in Pediatric Populations." Neurotoxicology and Teratology. Accepted for publication.
- 1993 Cook, M., Chappell, W.R., Mangioni, E., and Hoffman, R. "Assessment of Blood Lead Levels in Children Living in an Historic Mining and Smelting Community." American J. Epidemiology 137:447-455.

*Included are invited papers and technical reports which have been externally reviewed.

- 1992 Hutchinson, L.J., Amler, R.J., Lybarger, J.A., and Chappell, W.R. "Neuro Behavioral Test Batteries for Use in Environmental Field Studies." U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry. Dec., 1992.
- 1992 Calabrese, E., Beck, B., and Chappell, W.R. "Does the Animal to Human Uncertainty Factor (UF) Incorporate Interspecies Differences in Surface Area." J. Reg. Pharmacol. and Toxicol. 15:172-179.
- 1992 Chappell, W.R. "Scaling Toxicity Data Across Species." J. Environ. Geochem. and Health 14:71-80.
- 1991 Chappell, W. R. and J. Mordenti, "Extrapolation of Toxicological and Pharmacological Data from Animals to Humans." In Advances in Drug Research, vol. 20. Ed. B. Testa. Academic Press, Ltd., p.p. 1-116.
- 1991 Gratt, L. B., and W. R. Chappell. "Use of Risk Methodologies for Sewage Sludge Disposal Options." In: The Analysis, Communication and Perception of Risk. Eds. B. J. Garrick and W. C. Gekler, Plenum Press, NY, pp 237-245.
- 1989 Chappell, W. R. "Interspecific Scaling of Toxicity Data: A Question of Interpretation." Risk Anal. 9:13-14.
- 1989 Mordenti, J. and W. R. Chappell. "The Use of Interspecies Scaling in Toxicokinetics," In Toxicokinetics and New Drug Development, Eds. A. Yacobi, J.P. Skelly and V. K. Batra. Pergamon Press, N.Y. pp. 42-96.
- 1989 Chappell, W. R. and L. B. Gratt. "Risk Assessment Methodology" Published in Peer Review: Standards for the Disposal of Sewage Sludge: U. S. E. P. A. Proposed Rule CFR Parts-257 and 503, Published by U.S.D.A. Cooperative State Research Service Technical Committee W-170.
- 1987 Chappell, W. R. (first author), et al. "The Acidification Status of Colorado Lakes" in Acid Deposition in Colorado - A Potential or Current Problem, Editor R. A. Pielke, Colo. State University Press, 1987, pp. 3-12.
- 1987 Chappell, W. R. (first author), et al. "The Relationship Between Lake Water Chemistry and the Surrounding Landscape" in Trace Substances in Environmental Health Vol. XX. Editor D. D. Hemphill, University of Missouri Press, Columbia, 1987, pp. 446-456.

- 1985 Chappell, W. R., R. R. Meglen, and R. W. Klusman. "Chemical Classification of Colorado Lakes," Published in 19th Annual Proceedings of Trace Substances in Environmental Health, University of Missouri Press, pp. 109-118.
- 1985 Chappell, W. R. "Use of Surface Area for the Extrapolation of Noncarcinogenic Risks from Animals to Humans." Published in 19th Annual Proceedings of Trace Substances in Environmental Health, University of Missouri Press, pp. 326-337.
- 1983 Hubly, D., W. R. Chappell, J. Lanning, M. Maltempo, D. Chiras, and J. Morris. Risk Assessment of Wastewater Disinfection. Final Report to EPA. Grant No. R-806586-01. (Accepted by external reviewers).
- 1983 Chappell, W. R. and L. Gratt. The Environmental and Health Risks Associated with Shale Oil Production. 17th Annual Proceedings of Trace Substances in Environmental Health, University of Missouri, University of Missouri Press, p. 221-228.
- 1982 NRC Committee on Synthetic Fuels Facilities Safety (W. R. Chappell, member), Safety Issues Related to Synthetic Fuels Facilities. National Academy of Sciences/National Research Council, Washington, D.C.
- 1982 Chappell, W. R. Some Policy Issues Related to Synthetic Fuels Facility Safety in Safety Issues Related to Synthetic Fuels Facilities, NAS, Washington, D.C., pp. 94-98.
- 1982 Gratt, L. B., W. R. Chappell, B. W. Perry, W. M. Marine, D. A. Savitz, and J. L. Feerer. Health and Environmental Effects Document for Oil Shale -- 1982, Report to DOE, Reviewed by a National Academy of Sciences Committee, 72 pages.
- 1981 Chappell, W. R. Environmental Consequences of Oil Shale Production in the U.S.A. Proceedings of the Second Joint US-USSR Workshop on Health and Environmental Effects of Oil Shale Development, Tallinn and Estonia.
- 1981 Chappell, W. R. The DOE Oil Shale Task Force -- A Progress Report, In: Proceedings of the Oil Shale Symposium, Colorado School of Mines, Golden, Colorado, pp. 422-425.
- 1980 Chappell, W. R. The Oil Shale Task Force: Past, Present and Future. In: Proceedings of the 2nd Environmental Control Symposium, Department of Energy, Washington, D.C.
- 1980 Chappell, W. R. Environmental and Health Consequences of Shale Oil Production in the U.S.A. J. Geol. Soc., London 137:571-574.

- 1980 Chappell, W. R. Worker Health Concerns Related to Shale Oil Production. Proceedings of Synfuel Weekly Meeting on Environmental Aspects of Synfuel Development. Synfuels Weekly, Washington, D.C.
- 1979 Chappell, W. R., R. R. Meglen, R. Moure-Eraso, C. C. Solomons, T. A. Tsongas, P. A. Walravens, and P. W. Winston. Human Health Effects of Molybdenum in Drinking Water. EPA-600/1-79-006. 101 pages.
- 1979 Chappell, W. R. Trace Element Release and Transport Associated with Shale Oil Production. In: Proceedings of 12th Annual Oil Shale Symposium, Colorado School of Mines, Golden, Colorado, pp. 156-165.
- 1979 Chappell, W. R. The DOE/EV Task Force on the Environmental and Health Effects of Modified in situ Oil Shale Processes. In: Proceedings of 12th Annual Oil Shale Symposium, Colorado School of Mines, Golden, Colorado, pp. 149-155.
- 1979 Chappell, W. R. Environmental Impacts of Oil Shale. Changing Energy Use Futures, Eds. R. A. Fazzolare and C. B. Smith. Persamon Press, New York, pp. 521-528.
- 1979 Walravens, P., R. Moure-Eraso, C. C. Solomons, W. R. Chappell, and S. Bentley. Biochemical Abnormalities in Workers Exposed to Mo Dust. Archives of Environmental Health, 34:302-308.
- 1979 Tsongas, T. A., R. R. Meglen, P. A. Walravens, and W. R. Chappell. Molybdenum in the Diet: An Estimate of Average Daily Intake in the U. S. Am. J. Clin. Nutri., 33:1103-1107.
- 1978 Chappell, W. R. Toxic Trace Elements and Oil Shale Production. Proceedings of the 11th Oil Shale Symposium, Colorado School of Mines, Golden, Colorado, pp. 32-42.
- 1977 Chappell, W. R. and D. Runnells. The Oil Shale Project. In: D. D. Hemphill, ed., Trace Substances in Environmental Health, University of Missouri, Columbia, Vol. XI, pp. 383-388.
- 1975 Chappell, W. R. Some Comments on the Management of Problem-oriented Interdisciplinary Research. Proceedings of Second Annual NSF Trace Contaminants Conference, Lawrence Berkeley Laboratory, Berkeley, pp. 350-356.
- 1975 Runnells, D. D., W. R. Chappell, and R. R. Meglen. The Molybdenum Project: Geochemical Aspects. Geological Society of America, Special Paper 155, pp. 61-72.

- 1975 Chappell, W. R. Interdisciplinary Approach to Geothermal Development. In: J. E. Flack, ed., Proceedings of Conference on Interdisciplinary Analysis of Water Resource Systems, ASCE, New York, pp. 220-229.
- 1975 Chappell, W. R. Transport and Biological Effects of Molybdenum in the Environment. In: P. A. Krenkel, ed., Heavy Metals in the Aquatic Environment, Pergammon Press, New York, pp. 167-188.
- 1974 Chappell, W. R., R. R. Meglen, and D. D. Runnells. Comments on Directed Panspermia. *Icarus* 21:513-515.
- 1972 Chappell, W. R. A Physics oriented College Motivation Program for Minority Students. *Phys. Teacher* 10:188.
- 1972 Chappell, W. R. and R. H. Williams. Microscopic Theory of Conductivity of a Weakly Ionized Plasma. *Phys. Fluids* 15:1059.
- 1971 Chappell, W. R., J. Cooper, E. W. Smith, and T. Dillon. A Kinetic Theory of Spectral Line Shapes. *J. Stat. Phys* 3:401.
- 1971 Cooper, J., E. W. Smith, and W. R. Chappell. An Adiabatic Treatment of Ion Dynamics for Forbidden Line Profiles. *Phys. Letter* 24A:363-365.
- 1971 Chappell, W. R. and R. H. Williams. Density Fluctuations in a Magnetized, Weakly Ionized Plasma. *Phys. Fluids* 14:1938-1942.
- 1971 Smith, E. W., J. Cooper, W. R. Chappell, and T. Dillon. An Impact Theory for Doppler and Pressure Broadening; I. General Theory. *J. Quant. Spect. Rad. Transfer* 11:1547.
- 1971 Smith, E. W., J. Cooper, T. Dillon, and W. R. Chappell. An Impact Theory for Doppler and Pressure Broadening; II. Atomic and Molecular Systems. *J. Quant. Spect. Rad. Transfer* 11:1567.
- 1971 Williams, R. H. and W. R. Chappell. Microscopic Theory of Density Fluctuations and Diffusion in Weakly Ionized Plasmas. *Phys. Fluid* 14:591-598.
- 1970 Cooper, J., E. W. Smith, and W. R. Chappell. Non-thermal Effects in Stark Broadening. *J. Quant. Spect. Rad. Transfer* 10:1195.
- 1970 Chappell, W. R. Kinetic Equations of Autocorrelation Functions in Dilute Gases. *J. Stat. Phys.* 2:267.

- 1969 Chappell, W. R., J. Cooper, and E. W. Smith. Electron correlations in Stark Broadening. J. Quant. Spec. Rad. Transfer 9:149.
- 1969 Brittin, W. E. and W. R. Chappell. Functional Methods in Statistical Mechanics, Part I, Classical Theory. J. Math. Phys. 10:661-674.
- 1968 Chappell, W. R. Microscopic Approach to Kinetic Theory-- Inhomogenous Systems. J. Math Phys. 9:1921-1926.
- 1967 Chappell, W. R. Microscopic Approach to Kinetic Theory. J. Math Phys. 8:298.
- 1966 Chappell, W. R. and S. J. Glass. The Interaction of Radiation with Charged Particles -- II, Dispersion Relation for Transverse Modes. Nuovo Cimento 43:79.
- 1966 Chappell, W. R. and W. E. Brittin. Quantum Kinetic Equations for a Multicomponent System of Charged Particles and Photons. Phys. Rev. 146:75.
- 1966 Chappell, W. R. Kinetic Equation for the Electron-Phonon Gas. J. Math. Phys. 7:1163.
- 1966 Chappell, W. R. Kinetic Theory of Quantum Plasma and Radiation in an External Magnetic Field. Phys. Rev. 152:113.
- 1965 Chappell, W. R. The Interaction of Radiation with Charged Particles -- I. Nuovo Cimento 38:1187.
- 1965 Chappell, W. R. and R. J. Swenson. Guessing Kinetic Equations. Phys. Fluids 8:1195.
- 1962 Brittin, W. E. and W. R. Chappell. The Wigner Distribution Function and Second Quantization in Phase Space. Rev. Modern Phys. 34:720.

BOOKS AND BOOK CHAPTERS

- 1984 Chappell, W. R. Status Report: Health and Environmental Aspects of Oil Shale Technology. Synthetic Fossil Fuel Technologies, Butterworth Press, pp. 55-109.
- 1977 Chappell, W. R. and K. Petersen, eds. Symposium on Molybdenum in the Environment -- Proceedings, Vol. II, Marcel Dekker, New York.

- 1976 Chappell, W. R. The Molybdenum Project. In: W. R. Chappell and K. Petersen, eds., Symposium on Molybdenum in the Environment -- Proceedings, Vol. I., Marcel Dekker, New York.
- 1976 Chappell, W. R. and K. Petersen, eds. Symposium on Molybdenum in the Environment -- Proceedings, Vol. I., Marcel Dekker, New York.
- 1975 Chappell, W. R., F. C. Mann, and C. M. York. Review of Federal Research and Development Policy. In: J. A. Pulver and B. J. Polich, eds., Energy Development in the Rocky Mountain Region: Goals and Concerns, Federation of Rocky Mountain States, Inc., Denver, Vol. III, Chap. IX.
- 1971 Chappell, W. R. The Role of Plasma Kinetic Theory in Spectral Line Shapes. In: R. L. Liboff and N. Rostoker, eds., Kinetic Equations, Gordon and Breach Co., New York, pp. 99-109.
- 1967 Chappell, W. R. Microscopic Kinetic Theory. In: W. E. Brittin, ed., Lectures in Theoretical Physics, Gordon and Breach Co., New York, Vol. IXC, pp. 97-113.
- 1965 Brittin, W. E. and W. R. Chappell. Statistical Mechanical Basis of Magnethydrodynamics. In: W. E. Brittin, ed., Lectures in Theoretical Physics, University of Colorado Press, Boulder, Vol. VIIIA, pp. 101-143.
- 1965 Brittin, W. E. and W. R. Chappell, eds. Lectures in Theoretical Physics, Vol. VI, University of Colorado Press, Boulder.

NON-REFEREED PUBLICATIONS

- 1989 Lane, M.; W. R. Chappell, E. Mangione, and R. Meglen, "Heavy Metal Exposure Study in Leadville, CO," Report to A.T.S.D.R., U. S. Public Health Service. >
- 1988 Chappell, W. R., R. Meglen, R. Sistko, and L. Taylor. "The Acidification Status of Colorado Lakes: Part III - Final Report," Center for Environmental Sciences, University of Colorado at Denver.
- 1988 Chappell, W. R. "The Extrapolation of Toxicity Data from Laboratory Animals to Humans," Final Report to the Office of Drinking Water, W. S. E.P.A.
- 1987 Chappell, W. R. E. Mangione, and M. Cook. "Progress Report, Leadville Heavy Metal Exposure Assessment." Report to A.T.S.D.R., U. S. Public Health Service. >

- 1986 Chappell, W. R., et al. "Acidification Status of Colorado Lakes: Part II-Chemical Classification" Progress Report, Center for Environment Sciences, University of Colorado at Denver.
- 1985 Chappell, W. R., R. R. Meglen, G. A. Swanson, et. al. "Acidification of Status of Colorado Lakes: Part I. Chemical Classification." Center for Environmental Sciences, University of Colorado at Denver.
- 1985 Chappell, W. R., R. R. Meglen, and B. Kagey. "Final Draft for the Drinking Water Criteria Document on Molybdenum." Report to the Criteria and Standards Division, Office of Drinking Water, U. S. Environmental Protection Agency.
- 1984 Chappell, W. R. "Trace Element Enrichments in Coal Fly Ash and Applications to Emissions from Oil Shale Retorts." Contribution to the Health and Environmental Effects Document - 1984. Report to U.S.D.O.E. IWG Corporation, San Diego.
- 1984 Chappell, W. R. "Water Availability and Requirements for Oil Shale." Contribution to the Health and Environmental Effects Document - 1984. Report to U.S.D.O.E. IWG Corporation, San Diego.
- 1984 Chappell, W. R. "The Use of Surface Area as a Basis for Non-carcinogenic Risk Assessment." Report to the Criteria and Standards Division, Office of Drinking Water, U. S. Environmental Protection Agency.
- 1983 Chappell, W. R. Release and Transport of Heavy Metals Associated with Shale Oil Production. Heavy Metals in the Environment, CEP Consultants, Vol. II, pp. 801-805.
- 1982 Chappell, W. R., et al. Oil Shale Environmental Research and Coordination. Annual Report to DOE #10298-4.
- 1982 Chappell, W. R., et al. Oil Shale Environmental Research and Coordination. Three-year Progress Report to DOE, #10298-3.
- 1981 Chappell, W. R., ed. Progress Report, Environmental and Health Research at Lease Tract C-a. DOE Oil Shale Task Force, University of Colorado at Denver.
- 1981 Gratt, L. B., W. R. Chappell, B. W. Perry, J. L. Feerer, K. J. Berger, J. A. Lanning, R. A. Molano, and F. X. Smoky. Health and Environmental Effects Document for Oil Shale -- 1981. Technical Report to D.O.E.
- 1981 Chappell, W. R. et. al. Trace Elements in Oil Shale. Annual Report to DOE.

- 1981 The Oil Shale Task Force (W. R. Chappell, Chairman)
Environmental and Health Research Plan for Retort 1 at
Lease Tract C-a. A DOE Report Published by The Oil Shale
Task Force, University of Colorado at Denver.
- 1980 Chappell, W. R., et. al. Trace Elements in Oil Shale. Annual
Report to DOE.
- 1980 Task Force on Ecological Effects (W. R. Chappell, member).
Ecological Effects of Synthetic Fuels -- Research Needs, A
Report to the Federal Interagency Committee on the Health
and Environmental Effects of Energy Technologies. Mitre
Corp., McLean, Virginia.
- 1979 The Oil Shale Task Force (W. R. Chappell, Chairman).
Environmental Research on a Modified in Situ Oil Shale
Process. A DOE Report Published by The Oil Shale Task
Force, University of Colorado at Denver.
- 1979 Chappell, W. R., et. al. Trace Elements in Oil Shale. Annual
Report to DOE.
- 1979 Chappell, W. R. Heavy Metal Pollution from Shale Oil Produc-
tion. In: Proceedings of the International Conference
on Management and Control of Heavy Metals in the Environment,
Imperial College, London, England, pp. 592-595.
- 1979 Chappell, W. R., O. Louckes, et. al. Panel on Terrestrial
Effects, "Health and Environmental Effects of Oil Shale
Technology." Ed., R. Brown, DOE/HEW/EPA-02, MTR-79W00196,
Mitre Corp., McLean, Virginia.
- 1979 Chappell, W. R., C. C. Solomons, H. F. Walton, and W. L.
Weston. Health Effects of the consumption of Renovated
Water: Chemistry and Cytotoxicity. Final Report to
E.P.A. EPA-600/1-79-014. Available through NTIS.
- 1978 Chappell, W. R., et. al. Trace Elements in Oil Shale. Annual
Report to DOE.
- 1978 Walravens, P., R. Moure-Eraso, C. C. Solomons, W. R. Chappell,
and S. Bentley. Biochemical Changes in Workers Exposed to
Mo Dust. Proceedings of the Third Conference on Trace
Elements Metabolism in Animals, pp. 577-581.
- 1977 Chappell, W. R., et. al. Trace Elements in Oil Shale. Annual
Report to DOE.
- 1975 Chappell, W. R., et. al. Transport and the Biological Effects
of Molybdenum in the Environment, Progress Report to NSF,
ed. and author - The Molybdenum Project, University of
Colorado, Boulder, January 1.

- 1975 Mann, F. C., W. R. Chappell, et. al. Report of the Governor's Task Force on Energy Coordination. University of Colorado, Boulder.
- 1975 Chappell, W. R. Health Effects Relating to the Direct and Indirect Re-use of Wastewater for Human Consumption - Report of WHO Meeting of Experts. (contributor) Technical Paper No. 7, International Ref. Center for Community Water Supply, Amsterdam.
- 1974 Chappell, W. R. et. al. Transport and the Biological Effects of Molybdenum in the Environment, Progress Report to NSF, ed. and author-The Molybdenum Project, University of Colorado, Boulder, January 1.
- 1974 Chappell, W. R. Problems and Opportunities in Interdisciplinary Research: The Molybdenum Project. In: W. Fulkerson, W. D. Shults, and R. I. Van Hook, eds., Proceedings of First Annual NSF Trace Contaminants Conference, USAEC, Oak Ridge, Tennessee.
- 1973 Chappell, W. R. A Scientific and Policy Review of the Prototype Oil Shale Leasing Program -- Final Environmental Impact Statement of the U.S. Department of the Interior, (Contributor) K. Fletcher and M. F. Baldwin, eds., Institute of Ecology, Washington, D.C.
- 1973 Chappell, W. R. Interdisciplinary Approach to Geothermal Development. In: J. E. Flack, ed., Proceedings of Conference on Interdisciplinary Analysis of Water Resource Systems, ASCE, New York, pp. 220-229.
- 1972 Chappell, W. R., et. al. Transport and Biological Effects of Molybdenum. Progress Report to NSF. The Molybdenum Project, University of Colorado.
- 1969 Brittin, W. E. and W. R. Chappell. Investigation of the Dynamics of Ionized Media, Plasmas. U.S.A.R.L. Technical Report 69-0068.
- 1966 Chappell, W. R. Kinetic Theory of a Solid. University of California Technical Report. U.C.R.L. 70280.
- 1965 Brittin, W. E. and W. R. Chappell. Investigation of the Dynamics of Ionized Media (Plasmas). U.S.A.R.L. Technical Report 65-91.
- 1965 Chappell, W. R. Kinetic Equations for Systems of Charged Particles and Photons. University of Colorado Ph.D. Thesis, Published by J.I.L.A. Technical Report No. 35.
- 1965 Brittin, W. E., A. Y. Sakakura, and W. R. Chappell. Investigation of Dynamics of Ionized Media (plasmas). U.S.A.R.L. Technical Report 64-85.

PRESENTATIONS AT MEETINGS OR SEMINARS

- 1993 "Aspen vs EPA-The Role of a Technical Advisory Committee." International Congress on the Health Effects of Hazardous Waste. Invited Speaker, May, Atlanta, GA.
- 1992 "Leadville Heavy Metal Exposure Assessment." Seminar. Charles University, Prague, Czechoslovakia.
- 1991 "Scaling Toxicity Data." Colloquium. School of Pharmacy. Xavier University of Louisiana, New Orleans.
- 1991 "Clear Creek/Central City Exposure Study" International Conf. on Measuring, Understanding and Predicting Exposures in the 21st Century, Atlanta, GA.
- 1990 "Leadville Heavy Metal Study" Colloquium. London University, London, England.
- 1989 "Heavy Metal Exposure Survey in Leadville, Colorado." Annual Conference on Trace Substances in Environmental Health, Cincinnati, OH.
- 1986 "Acidification Status of Colorado Lakes." Washington State University, Pullman, WA, Invited.
- 1985 "Chemical Classification of Colorado Lakes." Presented at 19th Annual Conference on Trace Substances in Environmental Health. Columbia, Missouri, June.
- 1985 "Use of Surface Area for the Extrapolation of Noncarcinogenic Risks from Animals to Humans." Presented at 19th Annual Conference on Trace Substances in Environmental Health. Columbia, Missouri, June.
- 1983 The Environmental Impact of the Scottish Oil Shale Industry, Symposium for Center for Environmental Technology. Imperial College, October, Invited.
- 1983 The Environmental and Health Risks Associated with Shale Oil Production. 17th Annual Conference on Trace Substances in Environmental Health. Columbia, Missouri, June. Invited.
- 1983 Presented Poster Session on "The Release and Transport of Heavy Metals Associated with Oil Shale Production." International Conference on Heavy Metals in the Environment. Heidelberg.
- 1982 D.O.E.'s Environmental and Health Oil Shale Research Program: American Society of Civil Engineers. Fort Collins, CO, June, Invited.

- 1982 Status Report: Health and Environmental Aspects of Oil Shale Technology, Synthetic Fossil Fuel Technologies Symposium. Fifth Life Sciences Symposium. Gatlinburg, TN, October. Invited.
- 1982 Influence of Oil Shale Development on Water Quality. NAS Committee on Oil Shale Energy Minerals Research Workshop. Denver, CO, June. Invited.
- 1982 Oil Shale Research for Environmental Effects Management. Presented at American Society for Civil Engineers Convention. Las Vegas, NV, April. Invited.
- 1982 Some Policy Issues Related to Synthetic Fuels Facility Safety. Presented at the National Research Council Workshop on Synfuels Facility Safety. Washington, D.C., January. Invited.
- 1981 The D.O.E. Oil Shale Task Force -- A Progress Report. XIV Annual Oil Shale Symposium. Colorado School of Mines.
- 1981 Colloquium on Oil Shale Environmental Effects. Royal School of Mines, London.
- 1981 Environmental Impacts Resulting from Oil Shale Development. Presented at the American Geophysical Union Conference. Boulder, CO, September. Invited.
- 1981 Environmental Consequences of Oil Shale Productions in the U.S.A. Presented at Second Joint US-USSR Workshop on Health and Environmental Effects of Oil Shale Development. Tallin, Estonia, USSR, June. Invited.
- 1980 "Environmental and Health Consequences of Oil Shale Production in the U.S." Meeting of the Geological Society of London. Invited.
- 1980 Colloquium on Environmental Effects of Oil Shale. University of Southern California.
- 1980 Chaired Terrestrial Group on the Ecological Effects of Synthetic Fuels -- Research Needs for the Interagency Committee (DOE, EPA, NIH) on the Health and Environmental Effects of Synthetic Fuel Technologies. Oak Ridge, TN.
- 1980 Environmental and Health Consequences of Oil Shale Development. American Chemical Society. Las Vegas, NV, August. Invited.
- 1980 Worker Concerns Related to Shale Oil Production. Synfuels Weekly Meeting on Environmental Aspects of Synfuels Development. Denver, CO, June. Invited.
- 1979 Environmental Impacts of Oil Shale. International Conference on Energy Use Management. Los Angeles, CA. Invited.

- 1979 Heavy Metal Pollution from Shale Oil Production. International Conference on Management and Control of Heavy Metals in the Environment. London. Invited.
- 1979 The D.O.E./E.V. Task Force on the Environmental and Health Effects of Modified In Situ Oil Shale Processes. Presented at XII Annual Oil Shale Symposium. Colorado School of Mines. Invited.
- 1979 Trace Element Release and Transport Associated with Shale Oil Production. Presented at XII Annual Oil Shale Symposium. Colorado School of Mines.
- 1978 Co-Chaired Terrestrial Effects Panel at the Interagency (EPA, NIH, DOE) Workshop on the Health and Environmental Effects of Oil Shale. Denver.
- 1978 Toxic Trace Elements and Oil Shale Production. XI Oil Shale Symposium. Colorado School of Mines. Invited.
- 1978 Invited Participant in Workshop in Trace Substances in Environmental Health. Imperial College, London.
- 1977 The Oil Shale Project. Presented at the XI Annual Conference on Trace Substances in Environmental Health. University of Missouri, Columbia.
- 1975 Chaired Conference and Presented Paper on "The Molybdenum Project." International Symposium on Molybdenum in the Environment. Denver, CO.
- 1975 Member of WHO Meeting of Experts on the Health Effects Related to the Direct and Indirect Re-use of Wastewater for Human Consumption. Amsterdam. Only U.S. Representative. Invited.
- 1974 Plenary Address on "Some Comments on the Management of Problem-Oriented Interdisciplinary Research." Second Annual NSF Trace Contaminants Conference. Asilomar, CA. Invited.
- 1973 "Transport and Biological Effects of Molybdenum in the Environment." International Conference on Heavy Metals in the Aquatic Environment. Nashville, TN. Invited.
- 1973 "Problems and Opportunities in Interdisciplinary Research: The Molybdenum Project." The First Annual NSF Trace Contaminants Conference. Oak Ridge, TN. Invited.
- 1969 "The Role of Plasma Kinetic Theory in Spectral Line Shapes." Conference on Kinetic Equations. Cornell University. Invited.
- 1967 "Microscopic Kinetic Theory." Series of Lectures at Summer Institute for Theoretical Physics. Boulder, CO. Invited.

RECOGNITIONS, HONORS, ETC.

Phi Beta Kappa
Sigma XI
UCD Service Award for Outstanding Grant/Research Activity, 1981
Recognition Award for Services to the Society for Environmental Geochemistry and Health, 1983
Appointed Professor Preventive Medicine, UCHSC, 1977
Appointed Chair, D.O.E. Oil Shale Task Force by Assistant Secretary for Environment, 1978
Secretary/Treasurer, Councilor and Member of the Executive Board of the society of Environmental Geochemistry and health, Selected as member of Editorial Advisory Board, Journal of Chemistry and Ecology.
Environment Award. Presented by the Association of Metropolitan Sewerage Agencies to the W-170 Peer Review Committee. "EPA National Sewage Sludge Regulations" 1992.

PROFESSIONAL ORGANIZATIONS

American Physical Society
Society for Environmental Geochemistry and Health
American Association for the Advancement of Science
Society of Risk Analysis

OTHER PROFESSIONAL ACTIVITIES

Co-Chair, International Conference on Arsenic Exposure and Health Effects, July, 1993, New Orleans.

Co-Chair, Society for Environmental Geochemistry and Health Arsenic Task Force, 1992 to present.

Member, Society for Environmental Geochemistry and Health Lead in Soil Task Force. 1988 to present.

Chair, Technical Advisory Committee for Smuggler Mountain Superfund Site, Aspen, Colorado, 1992 to present.

Member, External Review Panel, Trail Community Lead Task Force, Trail, B.C., April, 1993.

Official participant, WHO, International Programme on Chemical Safety. Workshop on Toxicological Data Indicators, Atlanta, Georgia, Sept. 16-18, 1992.

Elected Secretary/Treasurer of Society for Environmental Geochemistry and Health, 1989-1991.

Member, EPA Technical Expert Committee on Sewage Sludge Disposal, Jan. 1990-Jan. 1992.

Chair, Risk Assessment Workgroup, USDA W-170 Peer Review Committee on EPAs Proposed Risk on Sewage Sludge Disposal, April, 1989-July, 1989.

Elected Councilor and Member of Executive Committee of the Society for Environmental Geochemistry and Health, 1981-1983, 1987-1989, 1991-1994.

Consultant, unpaid, at various times to the State of Colorado Health Department and Natural Resources Department

Consultant to: Los Alamos National Laboratory (member of the Director's Life Sciences Advisory Committee, 1980-1983), Science Applications, Inc., Engineering Sciences, I.W.G., E.P.A., and D.O.E.

Selected as member of WHO Expert Committee on the Health Effects of the Re-use of Water Water for Human Consumption. Amsterdam (1/75)

Selected as member of the Official U. S. Delegation (total of 6 members) to the Second Joint US-USSR Workshop on Health and Environmental Effects of Oil Shale Development. Tallinn, Estonia (6/81-7/81)

Selected as a member of the National Research Council Committee on Synfuels Research Council Committee on Synfuels Facilities Safety (11/81-6/82)

Co-Chairman (with O. Loucks) Terrestrial Effects Panel, Interagency (DOE/HEW/EPA) Workshop on the Health and Environmental Effects of Oil Shale Technology (1978)

RESEARCH SUPPORT

Grants and Contracts Activity

1969 - 1971	Fleishmann Foundation - \$8,000 - "College Motivation Program"
1970	Council on Research and Creative Work - \$4,000 - University of Colorado, "Environmental Transport of Molybdenum"
1971 - 1973	Denver Public Schools - \$8,000 - "College Motivation Program"
1971 - 1976	National Science Foundation - \$1,210,000 - "Transport and the Biological Effects of Molybdenum in the Environment"
1975 - 1978	Environment Protection Agency - \$350,000 - "Human Health Effects of Molybdenum"
1975 - 1978	Environmental Protection Agency - \$211,000 - "Human Health Effects of Water Re-use"
1975 - 1978	Ford Foundation and Rockefeller Foundation - \$20,000 - "Human Health Effects of Selenium in Drinking Water"
1976 - 1980	Department of Energy - \$1,300,000 - "Trace Contaminants in Oil Shale"
1976 - 1979	Environmental Protection Agency - \$287,000 - "Effect of Ozone on Organics in Wastewater."

- 1978 - 1979 Environmental Protection Agency - \$100,000 - "Critical Review of Research on Impact of Energy-Related Wastes on Aquatic Environment"
- 1978 - 1981 Department of Energy - \$1,470,000 - Pollution of Ground Water Due to Inactive Uranium Mill Tailings Piles"
- 1979 - 1981 Environmental Protection Agency - \$150,000 - "Evaluation of Risks, Energy Costs, and Associated Economic Factors of Wastewater Disinfection Alternatives"
- 1979 - 1981 Environmental Protection Agency - \$109,890 - "Chemistry of Renovated Wastewater"
- 1979 - 1981 U. S. Bureau of Mines - \$353,000 - "Groundwater Contamination Due to Uranium Mining and Milling"
- 1981 - 1982 Department of Energy, (\$549,000) "Oil Shale Health and Environmental Effects/Risk Analysis" (Formerly part of Trace Elements grant)
- 1981 - 1983 Department of Energy - \$1,214,263 - "Oil Shale Environmental Research and Coordination.
- 1982 - 1983 Department of Energy - \$178,603 - "Oil Shale Health and Environmental Effects/Risk Analysis
- 1983 - 1984 Council on Research and Creative work \$2,150 - University of Colorado Graduate School, Scottish Oil Shale Impacts
- 1984 - 1989 Consortium of Public Utilities, Coal Companies, and University of Colorado - \$331,500 - "Determination of Acidification Status of Colorado Lakes"
- 1987 - 1988 Agency for Toxic Substances and Disease Registry and Centers for Disease Control - \$67,780 - "Leadville Heavy Metal Exposure Study"
- 1989-1991 Agency for Toxic Substances and Disease Registry (ATSDR) - \$36,122 - "Clear Creek/Central City Mine Waste Exposure Study."
- 1992-1994 Agency for Toxic Substances and Disease Registry (ATSDR), Environmental Protection Agency (EPA), Health Canada, American Water Works Association (AWWA), American Mining Congress (AMC), International Council on Metals in the Environment (ICME), Electric Power Research Institute (EPRI), US BORAX. \$107,775. "International Conference on Arsenic Exposure and Health Effects," July 28-30, 1993. New Orleans, LA, and SEGHS Arsenic Task Force.

CURRICULUM VITAE

Paul B. Hammond

Born: Cleveland, Ohio 4-28-23

EDUCATION:

San Diego State College	1941-1942
Colorado State University	1942-1944
	1946-1949 D.V.M
University of Minnesota	1950-1955 Ph.D. (pharmacology)

EXPERIENCE:

General practice, Ontario, Oregon	1949-1950
Research fellow, University of Minnesota	1950-1951
Instructor, University of Minnesota	1951-1955
Associate Professor, University of Minnesota	1955-1961
Professor, University of Minnesota	1961-1972
Professor, University of Cincinnati	1972-Present

EDUCATIONAL RESPONSIBILITIES:

University of Minnesota
Veterinary pharmacology (major share)
Veterinary toxicology (major share)
Toxicology, graduate-level. The Medical School(one-third)
Toxicology, elective to medical students (minor share)
University of Cincinnati
Graduate toxicology training

PROFESSIONAL ACTIVITIES:

Toxicology study section, N.I.H.	1961-1965
Committee on Environmental Centers, B.S.S.	1965-1967
Advisory Council, National Institute of Environmental Health Sciences (NIEHS)	1967-1969
Consultant, NIEHS	1969-1974
Task Force on Research Planning in Environmental Health Science	1968-1969
Committee on Veterinary Drug Efficacy, N.R.C.	1967-1968
American Society of Pharmacology and Experimental Therapeutics, Committee on Goals and Manpower	1970
Committee on the Biological Effects of Atmospheric Pollutants, N.R.C., N.A.S.	1970-1972
Training Committee, NIEHS	1970-1972
Committee on Hazardous Trace Substances, Office of Science and Technology	1970-1972
Ad hoc Committee on Lead in Paint, N.R.C., N.A.S.	1974-1975

Task Group on Environmental Health Criteria for Lead,	
World Health Organization, consultant	1974-1976
Ad hoc Committee on Manpower and Training, Society of Toxicology	1976-1978
2nd Task Force on Research Planning in Environmental Health Science	1976
Editorial Board, Toxicology & Applied Pharmacology	1976-1990
Consulting editor, Archives of Environmental Health	1976-pres.
EPA, Office of Research and Development consultant for external review of "Air" Quality Criteria for Atmospheric Lead".	1976-1978, 1982.
EPA, Environmental Criteria and Assessment Office, Cincinnati, Consultant	1977-present
Board of Publications, Society of Toxicology	1979-1982
Editorial Board, Fundamental and Applied Toxicology	1981-1990
International Lead Zinc Research Organization and industries requiring consultation on lead related problems	Intermittent
Environmental Health Sciences Review Committee, NIEHS	1985-1989
EPA-Health Effects Review Board,	1992-
NIEHS-Workshop on "Effects of Environmental Chemicals on Lactation and Nursing Neonates"	1992

CURRENT SOCIETY MEMBERSHIPS:

Society of Toxicology
American Association of University Professors
American Association for the Advancement of Science

CURRENT GRANTS:

Principal investigator, National Institute of Environmental Health Science #ES01566-01A1, Behavioral Effects of Lead Exposure in Children, 1979-1996, approximately \$500,000/year, direct cost.

Principal investigator, National Institute of Environmental Health Sciences #ES05660, Mechanisms Underlying Lead-Induced Depression of Growth, 1991-1994, approximately \$80,000/y, direct cost.

JOURNAL ARTICLES:

1. Hammond, P.B. Dihydrostreptomycin Dose Serum Level Relationships in Cattle. J.A.V.M.A. 122: 203, 1953.
2. Hammond, P.B., Wright, H.N., and Roepke, M.H. A Method for the Detection of Lead in Bovine Blood and Liver. Minn. Agric. Exper. Sta. Tech. Bull. 221, 1955.
3. Hammond, P.B., and Sorensen, D.K. Recent Observations on the Course and Treatment of Lead Poisoning in Cattle. J.A.V.M.A. 130: 23, 1957.
4. Stowe, C.M., Hammond, P.B., Aronson, A.L, and Kriewaldt, F.H. A Survey of the Pharmacological Properties of Four Sulfonamides in Dairy Cattle. Cornell Vet. 47: 469, 1957.

5. Stevens, C.E., Hammond, P.B., and Nielsen, O.N. Phlegmonous Gastritis in Cattle Resulting from Ruminatoric Doses of Tartar Emetic. *J.A.V.M.A.* 134: 323, 1959.
6. Hammond, P.B, and Aronson, A.L. The Mobilization and Excretion of Lead in Cattle: A Comparative Study of Various Chelating Agents. *Ann. N.Y. Acad. Sci.* 88(2):498, 1960.
7. Aronson, A.L., and Hammond, P.B. Factors Limiting the Mobilization and Excretion of Lead by Ethylenediaminetetraacetate (EDTA). *Fed. Proc.* 22, No. 2: 190, 1963.
8. Aronson, A.L., and Hammond, P.B. Faster Analysis for Pb210 in Biological Specimens. *Nucleonics* 22: 90, 1964.
9. Hammond, P.B., and Aronson, A.L. Lead Poisoning in Cattle and Horses in the Vicinity of a Smelter. *Ann. N.Y. Acad. Sci.* III (Art. 2): 595, 1964.
10. Gehring, P.J., and Hammond, P.B. The Uptake of Thallium by Rabbit Erythrocytes. *J. Pharmacol. & Exper. Therap.* 145: 215, 1964.
11. Hammond, P.B., Dziuk, H.E., Usenik, E.A., and Stevens, C.E. Experimental Intestinal Obstruction in Calves. *J. Comp. Path. and Therap.* 74: 210, 1964.
12. Aronson, A.L., and Hammond, P.B. Effect of Two Chelating Agents on the Distribution and Excretion of Lead. *Jour. Pharmacol. & Exper. Therap.* 146:241, 1964.
13. Short, E.C., and Hammond, P.B. Ammonium Chloride as a Urinary Acidifier in the Dog. *J.A.V.M.A.* 144: 864, 1964.
14. Dunlop, R.H., and Hammond, P.B. D-Lactic Acidosis of Ruminants. *Ann. N.Y. Acad. Sci.* 119: 1109, 1965.
15. Hammond, P.B., and Aronson, A.L. The Efflux of Lead, with Particular Reference to the Liver and the Effects of EDTA. *The Pharmacologist* 8: 225, 1966.
16. Marten, G.C., and Hammond, P.B. Lead Uptake by Bromegrass from Contaminated Soils. *Agron. Jour.* 58: 553, 1966.
17. Hammond, P.B., Aronson, A.L., and Olson, W.C. The Mechanism of Mobilization of Lead By Ethylenediaminetetraacetate. *J. Pharmacol. and Exper. Therap.* 157:196, 1967.
18. Gehring, P.J., and Hammond, P.B. The Interrelationship Between Thallium and Potassium in Animals. *J. Pharmacol. and Exper. Therap.* 115: 187, 1967.
19. Aronson, A.L., Hammond, P.B., and Strafass, A.C. Studies with Calcium Ethylenediaminetetraacetate in Calves: Toxicity and Use in Bovine Lead Poisoning. *Toxicol. and Appl. Pharmacol.* 12: 337, 1968.
20. Hammond, P.B. Lead Poisoning, an Old Problem with New Dimensions. *Essays in Toxicology*, Vol. 1, 1969, Academic Press.

21. Hammond, P.B. The Effects of Chelating Agents on the Tissue Distribution and Excretion of Lead. *Toxicol. and Appl. Pharmacol.* 18: 296, 1971.
22. Airborne Lead in Perspective (NAS), 1972 (contributor).
23. Hammond, P.B. The Effects of D-penicillamine (PCA) on the Tissue Distribution and Excretion of Lead. *Toxicol. Appl. Pharmacol.* 26: 241, 1973.
24. Hammond, P.B. The Relationship Between Inhibition of Delta-aminolevulinic Acid Dehydrase by Lead and Lead Mobilization by Ethylenediamino Tetraacetate (EDTA). *Toxicol. and Appl. Pharmacol.* 26: 466, 1973.
25. Hammond, P.B. Metabolism and Metabolic Action of Lead and Other Heavy Metals. *Clin. Toxicol.* 6: 353, 1973.
26. Fleischer, M., Sarofim A.F., Fassett, D.W., Hammond, P., Shacklette, H.T., Nisbet L.C.T., Epstein, S. "Environmental Impact of Cadmium: A Review by the Panel on Hazardous Trace Substance". *Environmental Health Perspectives, Experimental Issue No. 7:253-323, (May), 1974.*
27. Hammond, P.B. Air Standards for Lead and Other Metals. *J. of Occup. Med.* 18: 351-355, 1976.
28. MacGee, J., Roda, S.M.B., Elias, S., and Hammond, P.B. Gas Chromatographic Analysis of Delta-Aminolevulinic Acid in Blood Plasma and Urine. *Federation Proceedings* 35: Abstract NO. 534 (May 15), 1976.
29. Johnson, D.R., Foulkes, E.C., and Hammond, P.B. The Renal Handling of Delta-Aminolevulinic Acid in Normal and Lead-Poisoned Rabbits. *Tox. Appl. Pharmacol.* 38: 101-109, 1976.
30. MacGee, J., Roda, S.M.B., Elias, S.V., Lington, A., Tabor, M.W., and Hammond, P.B. Determination of Delta-Aminolevulinic Acid in Blood Plasma and Urine by Gas-Liquid Chromatography. *Biochem. Med.* 17: 31-44, 1977.
31. Hammond, P.B. Exposure of Human to Lead. *Ann. Rev. Pharmacol. Toxicol.* 17:197-214, 1977.
32. Moeller, D.W., Pahl, H.B, and Hammond, P.B. Trends in University Environmental Health Research and Training. *Amer. J. Pub. Hlth.*, 69: 125-129, 1979.
33. Hammond, P.B. Development of Manpower Resources. In: *Symposium on the Handling of Toxicological Information.* G.J. Cosmides, Ed. National Technical Information Service, PB-283 164, 1978.
34. Hammond, P.B., Clark, C.S., Gartside, P.S., Berger, O., Walker, A., and Michael, L.W. Fecal Lead Excretion in Young Children as Related to Sources of Lead in Their Environment. *International Arch. Occup. Environ. Hlth.* 46:191-202, 1980.
35. O'Flaherty, E.J., Hammond, P.B., Lerner, S.I., Hanenson, I.B., and Roda, S.M.B. The Renal Handling of Delta-Aminolevulinic Acid in the Rat and in The Human. *Toxicol. Appl. Pharmacol.* 55: 423-432, 1980.

36. Hammond, P.B., Lerner, S.I., Gartside, P.S. Hanenson, I.B., Roda, S.B., Foulkes, E.C., Johnson, D.R., and Pesce, A.J. The Relationship of Biological Indices of Lead Exposure to the Health Status of Workers in a Secondary Lead Smelter. *J. Occup. Med.* 22: 475-484, 1980.
37. Hong, C.D., Hanenson, I.B., Lerner, S.I., Hammond, P.B., Pesce, A.J., and Pollack, V.E. The Effects on Renal Function of Occupational Exposure to Lead. *Kidney International.* 18: 489-502, 1980.
38. Hammond, P.B., O'Flaherty, E.J., and Gartside, P.S. The Impact of Air Lead on Blood Lead in Man - A Critique of the Recent Literature. *Food Cosmet. Toxicol.* 19: 632-638, 1981.
39. O'Flaherty, E.J., Hammond, P.B., and Taylor, E. Renal Reabsorption of Delta-Aminolevulinic Acid in the Rat. *Fund. Appl. Toxicol.* 1: 278-281, 1981.
40. Hammond, P.B., Hong, C.D., O'Flaherty, E.J., Lerner, S.I., and Hanenson, J.B. The Rat as an Animal Model of Lead Nephropathy: In *Nephrotoxic Mechanisms of Drugs and Environmental Agents*. Plenum Publishing Corp., New York, George Porter, ed., 1982.
41. O'Flaherty, E.J., Hammond, P.B., and Lerner, S.I. Dependence of Apparent Blood Lead Half-Life on the Length of Previous Lead Exposure in Humans. *Fund. Appl. Toxicol.* 2: 49-54, 1982.
42. Hammond, P.B. The Absorption and Disposition of Lead. In: *Assessment of the Safety of Lead and Lead Salts in Food*, A Report of the Nutrition Foundation's Expert Advisory Committee, R.A. Squire, ed. The Nutrition Foundation, Washington, D.C. 20006, June 1982.
43. Hammond, P.B. Clinical Significance and Biochemical Basis of Lead Toxicity in the World Population. In: Prasad, Ananda S., Editor: *Clinical, Biochemical, and Nutritional Aspects of Trace Elements*. New York, Alan R. Liss, Inc., 1982, pp. 513-519.
44. Hammond, P.B. Inorganics Lead in Man's Environment: Sources and Toxicological Significance. *J. Appl. Toxicol.* 2: 68-74, 1982.
45. Hammond, P.B., Bornschein, R.L., and Succop, P. Profiles of Lead Burdens in Early Childhood in: *Proc. Internat. Conf. on Heavy Metals in the Environment*. Heidelberg, W. Germany, Sept. 6-9, 1983, pp. 262-268.
46. Hammond, P.B., Bornschein, R.L., and Zenick, H. Toxicological Considerations in the Assessment of Lead Exposure. *Neurotoxicol.* 5: 53-66, 1984.
47. Bornschein, R., Berger, O., Clark, S., Dietrich, K., Hammond, P.B., Pearson, D, and Succop, P. The Cincinnati Prospective Study of Effects of Lead Exposure on Child Development. *Neurotox.* 5: 53-66, 1984.
48. Piscator, M., Foulkes, E., and Hammond, P. Early Detection of Renal Disease, in *New and Sensitive Indicators of Health Impacts of Environmental Agents*. *Proc. 3rd Annual Symposium on Environmental Epidemiology*, April 26-28, 1982. D.W. Underhill, E.P. Radford, eds., University of Pittsburgh, Pittsburgh, PA 15261.

49. Bornschein, R.L., Hammond, P.B., Dietrich, K.N., Succop, P., Krafft, K., Clark, S., Berger, O., Pearson, D., and Que Hee, S.S. The Cincinnati Prospective Study of Low Level Lead Exposure and Its Effects on Child Development. Protocol and Status Report. *Environ. Res.* 38: 4-18, 1985.
50. Bornschein, R.L., Succop, P., Dietrich, K.N., Clark, C.S., Que Hee, S., and Hammond, P.B. The Influence of Social and Environmental Factors on Dust Lead, Hand Lead and Blood Lead Levels in Young Children. *Environ. Res.* 38: 108-118, 1985.
51. Clark, C.S., Bornschein, R.L., Succop, P., Que Hee, S.S., Hammond, P.B., and Peace, B. Condition and Type of Housing as an Indicator of Potential Environmental Lead Exposure and Pediatric Blood Lead Levels. *Environ. Res.* 38:46-53, 1985.
52. Dietrich, K.N., Krafft, K.M., Pearson, D.T., Harris, L.C., Bornschein, R.L., Hammond, P.B. and Succop, P.A. The Contribution of Social and Development Factors to Lead Exposure During the First Year of Life. *Pediatrics* 75:1114-1119, 1985.
53. Hammond, P.B., Bornschein, R.L., and Succop, P. Dose-effect and Dose-response Relationships of Blood Lead to Erythrocytic Protoporphyrin in Young Children. *Environ. Res.* 38: 187-196, 1985.
54. Que Hee, S.S., Peace, B., Clark, C.S., Boyle, J.D., Bornschein, R.L., and Hammond, P.B. Evolution of Efficient Methods to Sample Lead Sources such as House Dust and Hand Dust in the Homes of Children. *Environ. Res.* 38: 77-95, 1985.
55. Dietrich, K.N., Krafft, K.M., Bornschein, R.L., Hammond, P.B., Berger, O., Succop, P.A. and Bier, M. Low-level Fetal Lead Exposure Effect on Neurobehavioral Development in Early Infancy. *Pediatrics* 80: 1117-1132, 1987.
56. Roda, S.M., Greenland, R., Bornschein, R.L. and Hammond, P.B. Modification of an anodic stripping voltammetry procedure for improved accuracy of blood lead analysis. *Clinical Chemistry* 34: 563-567, 1988.
57. Shukla, R., Bornschein, R.L., Dietrich, K.N., Mitchell, T., Grote, J., Berger, O., Hammond, P.B., and P.A. Succop. Effects of Fetal and Early Postnatal Lead Exposure on Child's Growth and Stature - The Cincinnati Lead Study. *6th International Conference of Heavy Metals in the Environment*. New Orleans, Vol. 1, p. 210, 1987.
58. Clark, C.S., Bornschein, R.L., Succop, P., Hammond, P.B., Peace, B., Krafft, K. and Dietrich, K. Pathways to Elevated Blood Lead and their Importance in Control Strategy Development. *6th International Conference of Heavy Metals in the Environment*. S.E. Lindberg and T.C. Hutchinson (Eds.), CEP Consultants Ltd., New Orleans, Vol. 1, pp. 159-161, 1987.

59. Succop, P.A., O'Flaherty, E.J., Bornschein, R.L., Clark, C.S., Krafft, K., Grote, J., Mitchell, T., Berger, O., Hammond, P.B. and Shukla, R. A kinetic model for estimating changes in the concentration of lead in blood of young children. In: Lindberg, S.E. and Hutchinson, T.C. (Eds.) CEP Consultants, Ltd., *Proceedings of the International Conference in the Environment*, Vol. 2, New Orleans, September 1987, pp. 289-291.
60. Bornschein, R.L., Succop, P.A., Dietrich, K.N., Krafft, K., Grote, J., Mitchell, T., Berger, O., Hammond, P.B. Prenatal lead exposure and pregnancy outcomes in the Cincinnati Lead Study. In: Lindberg, S.E. and Hutchinson, T.C. (Eds.), *Proceedings of the International Conference: Heavy Metals in the Environment*, Vol. 1, New Orleans, September, 1987, pp. 156-158.
61. Hammond, P.B., Chernausk, S., Succop, P., Shukla, R. and Bornschein, R. Mechanisms by which lead depresses linear and ponderal growth in weanling rats. *Tox. Appl. Pharmacol.*, 99:474-486, 1989.
62. Bornschein, R.L., Grote, J., Mitchell, T., Succop, P.A., Dietrich, K., Kraft, K.M. and Hammond, P.B. Effects of prenatal lead exposure on infant size at birth. In: *Lead Exposure and Child Development: An International Assessment*, M. Smith, L. Grant and A. Sors, (Eds.), Kluwer Academic Pub., Boston, 1989.
63. Shukla, R., Bornschein, R.L., Dietrich, K.N., Buncher, R., Berger, O., Hammond, P.B. and Succop, P. Effects of fetal and infant lead exposure on growth in stature. *Pediatrics* 84: 604-612, 1989.
64. Dietrich, K.N., Succop, P.A., Bornschein, R.L., Krafft, K.M., Berger, O., Hammond, P.B., and Buncher, C.R. Lead exposure and neurobehavioral development in later infancy. *Environ. Health Perspect.* (in press).
65. Hammond, P.B. and Dietrich, K.N. Lead exposure in early life: Health consequences. *Reviews of Environmental Contamination & Toxicol.* 115:91-124, 1990.
66. Hammond, P.B., Minnema, D.J., and Shukla, R. Lead exposure lowers the set point for food consumption and growth in weanling rats. *Toxicol. Appl. Pharmacol.* 106:80-87, 1990.
67. Hammond, P.B., Jones, M.M., Succop, P.A., Singh, P.K., Basinger, M.A. Validity of femur and tibia as surrogates for total skeletal burden of lead. *Toxicol. Methods* 2(3):169-176, 1992.

BOOKS:

P.B. Hammond in: *Veterinary Pharmacology and Therapeutics*. L.M. Jones ed., 3rd ed. 1965. Iowa State University Press, Ames, Iowa. CHAPTERS: A. Drugs Altering Fluid Balance. B. Other Beneficial Minerals. C. Toxic Minerals. D. Rodenticides.

E.C. Foulkes and P.B. Hammond in: *Toxicology, The Basic Science of Poisons*. L.J. Casarett and J. Doull, eds., 1st ed. 1976. Macmillan Publishing Co., Inc., New York. CHAPTER: Toxicology of the Kidney

P.B. Hammond and R.P. Beliles in: *Toxicology, The Basic Science of Poisons*. J. Doull, C. Klaassen, M.O. Amdur, eds., (1980) MacMillan Publishing Co., Inc., New York. CHAPTER: Metals

P.B. Hammond in: *Quick Reference to Clinical Toxicology*. I.B. Hanenson, ed. (1980) J.B. Lipincott Co., Philadelphia. CHAPTER: Metals

P.B. Hammond in: *Current Topics in Nutrition and Disease*, A.S. Prasad, ed. (1982). Alan R. Liss, Inc., New York, NY. CHAPTER: Clinical Significance and Biochemical Basis of Lead Toxicity in the World Population.

P.B. Hammond and E.C. Foulkes in: *Metal Ions in Biological Systems*, Vol. 20, H. Sigel, ed. (1985) Plenum Press. CHAPTER: Metal Ion Toxicity in Humans and Animals

Piscator, M., Foulkes, E.C., Hammond, P.B. in: *New and Sensitive Indicators of Health Impacts of Environmental Agents*, Underhill, D.W., Radford, E.P., eds. (1986). University of Pittsburgh, Pittsburgh, PA. CHAPTER: Early Detection of Renal Disease.

Hammond, P.B., Gartside, P.S. in: *Biological Monitoring of Toxic Metals*. T.W. Clarkson, L. Friberg, G.F. Nordberg, P.R. Sager, eds. (1988). Plenum Publishing Corp. CHAPTER: Biological Media - Their Advantages and Pitfalls When Used in Biological Monitoring-Feces.

Succop, P.A., Hammond, P.B., Bornschein, R.L., Roda, S.B., Greenland, R.D. in: *Lead Exposure in Childhood Development: An International Symposium*. M. Smith and L. Grant, eds. (1988) Kluwer, Lancaster, U.K. CHAPTER: Recent observations concerning the relationship of blood lead to erythrocytic protoporphyrin.